

The importance of mycological research and directions of future research in the liberated territories of Azerbaijan

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The presented work substantiates the importance of mycological assessment of the current ecological situation in the liberated territories of Azerbaijan and its implementation due to changes caused by both the occupation factor and global problems on the planet. The assessment of a specific biotope would be incomplete without studying the fungi that are actively involved in all the ecological functions that occur in nature. Therefore, the implementation of research in accordance with the priority areas of the world is important both from a scientific and practical point of view and will allow the realization of the probability of achieving interesting results.

Keywords: *Occupied territories, natural resources, bioresources, fungi, biologically active substances, phytopathogenic fungi*

INTRODUCTION

The state of natural resources used in various areas (industry, agriculture and household), first of all, quality indicators are determined by various criteria, one of them and the most important is related to biotic factors. Since this indicator covers all taxonomic groups of living things on Earth, it is a matter of special attention and worries everyone. Despite the fact that the quality of resources depends on humans, every year a large group of living things, as well as humans, get sick and even die due to biological contamination of resources used (food, feed, medical, technical, etc.) for various purposes (Ucar et al., 2016). For this reason, identification, forecasting and management of biological pollution of resources is one of the current areas of research widely conducted in the world today (Altenburger et al., 2019; Tran et al., 2020).

The liberated territories of the Karabakh region as a result of the 44-day counter-offensive of our victorious army under the leadership of the President of the Republic of Azerbaijan, Supreme Commander-in-Chief Ilham Aliyev are of greater importance against the background of the above-mentioned tasks. This is confirmed by the following:

First, the territories of Azerbaijan occupied since 1988 with the help of the patrons of the Republic of Armenia, are rich and colorful in nature (https://files.preslib.az/projects/azereco/ru/eco_m2_6.pdf). Thus, there are more than 2000 plant species, in the plain places such as wormwood, wormwood-saline semi-border, steppe and semi-steppe vegetation in the foothills, shrubs on mountain slopes, deciduous forests cover a large area. Subalpine and alpine meadows are at an altitude of 2000-2300 m above sea level. Due to all forms of crop production, the wide diversity of flora and fauna, diversity of natural resources and large reserves, it was not only lagging behind other territories of Azerbaijan but in some respects was characterized by superior performance. The number of sunny days a year is 2000-2400 hours there. Soil types are also characterized by a wide variety, and here are found chestnut, light chestnut, brown mountain-forest, brown mountain forest, dark mountain-meadow and other soil types (<https://www.virtualkarabakh.az/az/post-item/26/45/qarabag-tebieti.html>). These areas are also characterized as areas of distribution of animal and plant species included in the "Red Book of Azerbaijan" (2013).

Secondly, due to the occupation, scientific research was not carried out by the Institutions of the Republic of Azerbaijan. If the study was carried out, it covered a certain part of the occupied territories. For example, in 1986, I and Ph.D. H.E.Kanigina, an employee of the Institute of Botany of ANAS, began to conduct field mycological studies in the forests of the Kelbajar and Lachin regions, but we could not bring these studies to a definite result, since then those territories have been closed for such studies. It should be added that even during the Soviet era, there were special difficulties in clarifying a number of issues in the Daglig Karabakh (in the territory of the former Daglig Karabakh Autonomous Region). In short, the liberated territories are characterized as hardly studied areas for the Azerbaijani scientific community for about a century.

Third, the occurrence of specific anthropogenic pollution as a result of military operations in the territories, large and small-scale military conflicts, and depending on its character in nature, primarily in the bioresources of the area creates specific changes. Sufficient research material (Linden et al., 2004; Rueveny et al., 2010) confirms that changes in these types of effects are often negative.

Fourth, it is a form of the attitude of the occupiers towards the territories. Thus, the occupation is to give preference to approaches to the natural resources of these areas, which are difficult for the human mind to understand, and which, without exaggeration, can be called both biological and environmental terrorism. The aggravation of the situation was aggravated by the fact that the Republic of Armenia didn't accede to international conventions on the protection and efficient use of natural resources, as well as military conflicts (for example, related to transboundary waters). The results of preliminary research conducted by various governments (Ministry of Ecology and Natural Resources) (<https://sputnik.az/20201023/azerbaycanin-bitki-ortuyunun-qirx-iki-425274032.html>) and scientific institutions (Institute of Microbiology, Soil Science and Agrochemistry of ANAS) of the Republic of Azerbaijan prove it today. Thus the analysis of samples taken from the water, soil and plant of the liberated territories, it observed the negative effects on both nature and human health. For example, in our researches at the Institute of Microbiology of ANAS, in some rivers of the liberated territories in

the Fizuli region, the amount of heavy metals exceeded the permissible concentration, the number of microbiota and moisture decreased, the background toxicity increased, etc. confirmed. In addition, the field observations of the Institute's staff in Shusha and in the Lachin corridor, as well as the initial laboratory analysis of water and soil samples taken from there, gave serious grounds to say that the occupation factor had a significant impact on the area and that these facts were negative.

Finally, as a result of increasing anthropogenic impacts on the environment, global problems (desertification, climate change, biodiversity degradation, salinization, etc.) are emerging and increasingly affecting all parts of the world to one degree or another (McMichael et al., 2008). This, in turn, has made it necessary to re-evaluate the natural resources, including bioresources of the areas studied extensively some time ago (20-30 years ago) in response to changing conditions. Because bioresources are more sensitive to both pollution and the effects of pollution. Thus, the interactions between plants, animals, fungi, and other living things that make up biodiversity determine the state of an ecosystem, and therefore any factor that causes them to change at the same time causes the ecosystem to change as a whole (Fisher et al., 2006). In order to restore the status quo of the occupied territories in accordance with today's realities and to prepare a scientific basis for its effective use, it is necessary to study all the creatures that have settled there and are potentially bioresources. Thus, one of the main problems of modern biological science, as well as various fields (botany, zoology, mycology, etc.) is the development of scientific and practical bases for the protection of biodiversity on earth and their use in accordance with the principles of sustainable development. To this end, research such as the complex relationships between the individual components of any ecosystem and their functional significance, as well as a comprehensive study of the development dynamics, interactions and productivity of various biocomponents in the ecosystem (Perotto et al., 2013) are important.

It should be noted that while the number of eukaryotic organisms (plants, animals and fungi) on Earth is now known to be more than 2 million, the number of actual worlds in nature is much higher. For example, the number of eukaryotic species on Earth is estimated to be 8.7 million (Mora et al., 2011).

It should be noted that fungi, which are important components of the heterotrophic block of any ecosystem where bioresources are important and contain organic matter, lag behind both animals and plants in terms of the number of species. Thus, according to classical approaches, the number of species of fungi identified for science is now equal to 100 thousand, which is several times less than the species of plants and animals known to science. Nevertheless, fungi are actively involved in all environmental functions (production, destruction, identification and regulation) that occur in nature (Schmit and Mueller, 2007). Thus, on the one hand, fungi that are actively involved in the pollution of resources and regulation of species composition of biodiversity, on the other hand, the mineralization of organic matter (Arefyev, 2010) with soil and water, as well as various metabolites they also take an active part in enrichment. Among these metabolites are those that are useful in terms of both practical needs (various polysaccharides with functional activity, surface acids, photohormones, etc.) (Bakhshaliyeva et al., 2020; Frljak et al., 2021; Hoeksma et al., 2019) but also dangerous to human health (mycotoxins) (Greef-Laubscher et al., 2020). It is no coincidence that mushrooms are considered to be figuratively disrupting harmony in nature, confusing researches and descendants of the devil, and are now considered a major threat to food security in the world (Hyde et al., 2018). Therefore, without these studies, research aimed at assessing any ecosystem cannot be considered comprehensive. Therefore, attention should be paid to research in the liberated areas, and fungi should be one of the most widely studied organisms.

It would be appropriate to touch on the issue of fungi, which is related to the number of species of fungi. As mentioned, there is a difference between the actual number of living things on Earth and the number of species of living things known to science, and this difference is for the benefit of nature. The idea that the number of fungal species assigned to classical approaches (based on cultural-morphological and physiological characteristics) is 7-8% of those that exist in nature no longer reflects reality, and the number of species of fungi that exist in nature 1.2-1. Not 5 million (Hawksworth, 2004), not 3.5-5.1 million (Blackwell, 2011), 12 million according to molecular phylogenetic approaches (Wu et al., 2019), and this figure will be one in the future is likely to rise as much.

At present, the study of fungi is carried out in several aspects, and if we summarize the research conducted in connection with their study, it is clear that the research conducted in connection with their study is devoted to solving the following tasks:

Determination of the species composition of fungi as one of the important components of biodiversity on Earth based on modern molecular genetic methods;

Search for active producers of biologically active substances, including various substances with pharmacological activity, selection of active producer and determination of the effect of the obtained substances, the field of application, development of production technology;

Diseases caused by fungi, development of methods for their prevention and identification of opportunities for the use of fungi in biological control;

The use of fungi as strain – producers, which allows making non – traditional substrates suitable for practical use by biological conversion, obtaining biomass energy, etc.

According to the above, if we try to assess the liberated territories, we must first note that, in general, the first mycological studies in Azerbaijan were conducted in these liberated territories (quoted from Akhyndov et al., 2008), which coincided with the 4th quarter of the XIX century. This is one of the new facts that will be noted in a positive light in terms of mycological assessment of the liberated territories of the Karabakh region, which today is important only in terms of the history of mycological research. The cases of timely collection and herbarium samples collected from these areas (for example, in the Institute of Botany of ANAS) can be considered as positively evaluated, but they are also the most historically important at the present stage of development of mycology.

CONCLUSIONS

Thus, for the above reasons, recalling that no systematic mycological research was carried out even before the occupation and that all living and non-living components of the area changed as a result of both occupation and natural processes, these areas are now open for mycological research. It is safe to say that it is an interesting object. At the

same time, if we take into account that the natural soil, climate, flora and fauna on the region are in a sense specific, the quantitative indicators of the producer of one or another feature are so variable at the strain level, then at least 30 years of full scientific research there will be no doubt that interesting results will be obtained both from a scientific and practical point of view in a remote and diverse area. Therefore, it is necessary to conduct mycological research in the liberated territories, to assess the current ecological condition of the liberated territories, restoration and efficient use of resources, as well as to scientifically assess the potential of biodiversity inherent in the nature of Azerbaijan is the issue.

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Azərbaycanın işğaldan azad olunmuş ərazilərində mikoloji tədqiqatların aparılmasının zəruriliyi və gələcək tədqiqat istiqamətləri

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Təqdim olunan işdə Azərbaycanın işğaldan azad olunmuş ərazilərinin müasir ekoloji vəziyyətinin mikoloji cəhətdən qiymətləndirilməsinin vacib olması və bunun həm işğal faktorundan irəli gələn, həm də planetdə baş verən qlobal xarakterli problemlərdən yaranan dəyişikliklərə görə həyata keçirilməsi əsaslandırılır. Təbiətdə baş verən bütün ekoloji funksiyalarının hamısında aktiv şəkildə iştirak edən göbələkləri tədqiq etmədən konkret bir biotipun ekoloji vəziyyətinin qiymətləndirilməsinin yarımçıq olmasına səbəb olması və bu səbəbdən də tədqiqatların dünyada aprılanların prioritet istiqamətlərə müvafiq aparılması həm elmi, həm də praktiki baxımdan əhəmiyyət kəsb edən nəticələrin əldə edilməsini zəruriləşdirəcəkdir.

Açar sözlər: *İşğal olunmuş ərazilər, təbii ehtiyatlar, bioresurslar, göbələklər, bioloji aktiv maddələr, fitopatogen göbələklər*

Важность микологических исследований и направления будущих исследований на освобожденных территориях Азербайджана

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В представленной работе обосновывается важность микологической оценки современной экологической ситуации на освобожденных территориях Азербайджана и её реализации в связи с изменениями, вызванными как оккупационным фактором, так и глобальными проблемами на планете. Без исследования грибов, которые активно задействованы во всех экологических функциях природы, оценка экологического состояния того или иного биотопа является неполной, и поэтому проведение исследований, согласно приоритетным направлениям в мире, сделает необходимым получение как научно-, так и практически значимых результатов.

Ключевые слова: *Оккупированные территории, природные ресурсы, биоресурсы, грибы, биологически активные вещества, фитопатогенные грибы*